PICK MECHANISM

FIELD OF THE INVENTION

The invention relates to a pick mechanism for paper and particularly to a pick mechanism that has a simple structure and saves space.

BACKGROUND OF THE INVENTION

With ever changing of digital technologies, many electronic products have become very popular. The advance of technologies also makes these electronic products more compact and miniaturized. In addition, functional integration also has become a trend and an appeal in the market place.

In the office environments, it is very common to integrate business machines such as a printer, copier, and FAX machine to become a Multi-Function Peripheral (MFP) that combines the functions of copying, printing, facsimile and scanning. Whether single function or multiple functions, the process of miniaturization has to rearrange and reorganize the physical structure. In these products, a paper conveying mechanism, including a paper picking and transfer mechanism, has to be simplified.

In general, the paper conveying mechanism used in the copiers, printers or FAX machines usually has two rubber rollers with a greater friction coefficient. One is a pickup roller and the other is a feed roller. The top sheet of a paper is first separated by the pickup roller, and then is transported by the feed roller to the printing module for printing. The driving power source usually is located between the two rubber rollers. A transmission element such as a gear set or belt is used to transmit the driving power to the two rollers.

For the pick mechanism that uses the pickup roller to fetch paper, the gear to transmit power will generate friction and result in energy loss and noise. Thus, it is preferable to use as few gears as possible. Another requirement for the pick mechanism is to prevent multi-feeds or failed feeds caused by varying of paper properties such as weight, density or stiffness.

In order to equip the pickup roller with automatic compensating capability, the pickup roller usually is movable. Such a design makes the pick mechanism more complicated. It also takes more space. For instance, LEXMARK Co. of U.S.A, has disclosed U.S. Patent No. 5,527,026 which has a drive roller (13) pivotally engaged on a bottom gear of a gear train (1). The drive gear (3) at the front end of the gear train is stationary. The entire gear train (1) and the drive roller (13) are movable depending on the amount of paper. The drive roller (13) is in contact with the surface of the top sheet. When all the gears in the gear train (1) rotate to drive the drive roller (13), a torque is generated to enable the drive roller to apply a normal force to the top sheet. The normal force alters according to the characteristics of paper, thus can automatically compensate the pickup force, depending on the characteristics of paper, to avoid the problems of multi-feeds or failed feeds.

In other words, if the drive roller is mounted on a movable end of a swinging arm (such as the gear train), the drive roller may be in contact with the top sheet all the time regardless the amount of paper in the paper tray. Meanwhile, it can increase or decrease a normal pick-up force according to the characteristics of paper.

However, the pick mechanism that adopts the swinging arm still is not perfect. For instance, in the U.S. Patent No. 5,527,026 assigned to LEXMARK Co., every gear in the gear train (1) is fixed relative to another. When the entire gear train (1) is swung for paper picking, it does not have much space to move. Moreover, when the quantity of paper changes (or the depth of paper tray alters), the moving path is not extended

directly from the drive gear to the paper, but moves sideward in the swinging direction. Hence, a greater space must be reserved to accommodate the swinging of the entire gear train (1). It does not meet the miniaturization requirement.

SUMMARY OF THE INVENTION

Therefore, the primary object of the invention is to resolve the previously mentioned disadvantages occurred to the conventional pick mechanisms such as bulky size, complicated structure, higher cost and a spatial design problem.

The invention provides a pick mechanism that mainly includes a transmission gear, an idling gear, a swinging arm, a pickup gear and a pickup roller. The transmission gear is connected to a power input shaft. The idling gear is engaged with the transmission gear, and the axis of the idling gear is coupled with the power input shaft through a first linkage bar. The pickup gear is engaged with the idling gear, and the axis of the pickup gear is coupled with the axis of the idling gear through a second linkage bar. The pickup roller is located on one side of the pickup gear and is coupled on a same pivot shaft with the pickup gear. When the power output shaft drives the transmission gear, the power is transmitted through the idling gear and the pickup gear to drive the pickup roller to rotate in the direction of paper feeding. The pickup roller applies a force on the top sheet of paper contained in the paper tray to move the top sheet.

The invention aims at achieving effects such as enabling the pickup roller to compensate the pickup force automatically, simplifying the structure, adjusting the operation mechanism and reducing the space needed.

The foregoing, as well as additional objects, features and advantages of the invention will be more readily apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a first embodiment of the invention, with the paper tray indicated by broken lines.

FIG. 2 is a perspective view of the first embodiment of the invention, with the paper tray and the outer frame indicated by broken lines.

FIG. 3 is a perspective view of the first embodiment of the invention from another side.

FIG. 4 is a side view of the first embodiment of the invention, with the side- wall of the paper tray removed.

FIG. 5 is a schematic view of the first embodiment of the invention showing the pick mechanism in a paper pickup condition.

FIG. 6 is a schematic view of the first embodiment of the invention showing the pick mechanism in a paper feeding condition.

FIG. 7 is a schematic view of the second embodiment of the invention showing the pick mechanism in a paper pickup condition.

FIG. 8 is a schematic view of the second embodiment of the invention showing the pick mechanism in a paper feeding condition.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Refer to FIGS. 1 through 6 for a first preferred embodiment of the invention. The pick mechanism 100 of the invention is located in a paper tray 200. It includes an outer frame 110, and a transmission gear 120, an idling gear 130, a pickup gear 140 and a pickup roller 150 located in the outer frame 110. Details of the structural and operational relationship of the elements will be elaborated as follows.

Referring to FIGS. 1 through 4, the outer frame 110 is formed in an U-shape. It has one side fastening to a rectangular linkage block 111. The linkage block 111 is fastened to an inner side of a side- wall 210 of the paper tray 200. Namely, the outer frame 110 is stationary. The outer frame 110 has straight retaining slots 112 (referring to FIG. 1) and 113 (referring to FIG. 3) closed to one end, and is run through by a power input shaft 121. The power input shaft 121 runs through two side- walls 210 (only one sidewall is shown) of the paper tray 200. In this embodiment, the power- input shaft 121 provides rotation power in one direction (clockwise direction, as shown in FIGS. 5 and 6).

The transmission gear 120 is mounted on the power input shaft 121 inside the outer frame 110 and may be driven by the power input shaft 121 to rotate. As the axis of the power input shaft 121 is fixed, the axis of the transmission gear also is fixed.

The idling gear 130 is engaged with the transmission gear 120. Its axis is coupled with the power input shaft 121 through a first linkage bar 160. The first linkage bar 160 is formed in a plate.

The pickup gear 140 is engaged with the idling gear 130. Its axis is coupled with the axis of the idling gear 130 through a second linkage bar 170.

The pickup roller 150 and the pickup gear 140 are coupled on the same pivot shaft 180 and may rotate synchronously. The pivot shaft 180 has one end running through the second linkage bar 170 and the retaining slot 112 of the outer frame 110 (referring to FIG. 1) and other end running through the retaining slot 113 (referring to FIG. 3). The pickup roller 150 is a composite structure different from the conventional pickup roller, which has a roller surface made of a single material. Instead, the roller surface of the invention is divided into two sections. One section is a high friction surface 151, which has a greater friction coefficient, and other section is a low friction surface 152, which has a lower friction coefficient (referring to FIGS. 3 and 4). The low friction surface 152 has two feed wheels 153. In practice, the lower friction surface 152 and the feed wheels

153 may be made from hard plastics that have a smooth surface.

The structural elements and their relationship with the pick mechanism 100 are depicted as above. Referring to FIGS. 5 and 6, also FIGS. 1 through 4, during paper pickup process, the power input shaft 121 provides rotational power (clockwise direction) to drive the transmission gear 120, idling gear 130, pickup gear 140 and pickup roller 150 in this order. Moreover, the pickup roller 150 rotates clockwise in the direction of the paper feeding direction 220.

In the pick mechanism 100, the idling gear 130, pickup gear 140 and pickup roller 150 are movable, and the first linkage bar 160 and the second linkage bar 170 are swingable. Thus during operation there are frictions between the rotating gears and the linkage bars. As a result, the first linkage bar 160 is subject to a clockwise torque 221 while the second linkage bar 170 is subject to a counterclockwise torque 222. Overall, the pick mechanism100, except the stationary portions, has a tendency of moving in the direction of paper 230 in the paper tray 200. In addition, the pivot shaft 180 of the pickup roller 150 and pickup gear 140 is confined in the retaining slots 112 and 113 (with the retaining slot 113 not shown in the drawings). The pickup roller 150 finally will be moved downwards in a biased manner. However, it is largely moved towards the paper 230.

When the high friction surface 151 of the pickup roller 150 touches the paper 230, due to the constraints of the torque 221 and 222, and the retaining slots 112 and 113, a normal force 223 will be exerted on the paper 230. And the normal force 223 will increase gradually until the paper 230 is moved in the direction of the paper feeding direction 240. Namely, the amount of normal force 223 varies depending on the properties of paper such as weight, density or stiffness. Therefore, it can automatically compensate pickup force according to the properties of paper without the problems of multi-feeds or failed feeds. This is the so- called automatic compensation capability.

Referring to FIG. 6, when the paper 230 is moved in the paper feeding direction for a distance D, and reaches the feed roller 300, the pickup roller 150 is also turned from the high friction surface 151 to the lower friction surface 152 with the feed wheels 153 in contact with the paper 230. The feed roller 300 picks up the paper 230 and moves the paper in the paper feeding direction 240. The paper feed wheels 153 merely rotate with the paper 230 without affecting the movement of the paper 230. When the paper 230 is separated from the paper feed wheels 153, the pickup roller 150 rotates to make the high friction surface 151 touching the next sheet.

It is obvious that the length of the high friction surface 151 of the pickup roller 150 and the distance D of the paper 230 being moved to the feed roller 300 are closely related. The length of the low friction surface 152 and the time for the pickup roller 150 to touch the next sheet also are related. These factors must be adjusted during implementation to match the automatic control operation. Moreover, while not affecting the movement of the paper 230, the paper feed wheels 153 may be removed. In addition, the low friction surface 152 may be formed in an arched fashion to couple with the high friction surface 151 to form a complete circular surface.

In addition, the roller surface of the pickup roller may also be an entirely high friction surface. Refer to FIGS. 7 and 8 for a second embodiment of a pick mechanism 400 of the invention. The main difference from the first embodiment is that the pickup roller 410 has only a high friction surface 411. A fine-tuning adjustment must be made for the automatic control mechanism. During paper pickup, the power input shaft 420 turns in clockwise direction to drive the pickup roller 410, moving in the paper feeding direction 510, to contact and pickup paper by rotating. Once the paper 510 arrives in the feed roller 500, the power input shaft 420 rotates counterclockwise to move the pickup roller 410 away from the paper 510 without impeding the continuous movement of the paper 520. Next, in this embodiment, the power- input shaft 420 may provide bi-directional

rotations clockwise and counterclockwise, while the first embodiment provides only single direction rotation.

It is to be noted that the outer frame of the invention can provide stability for the entire mechanism during operation and provide a moving path for the retaining slots to confine the pickup roller. However, it is not mandatory in practice. When the outer frame is removed, slots may be formed on the paper tray to replace the retaining slots on the outer frame to enable the coaxial pivot shaft of the pickup gear and pickup roller to couple and move to confine the moving path of the pickup roller.

In short, the invention is different from the conventional pickup mechanism that employs a swinging arm (such as U.S. patent No. 5,527,026 to LEXMARK Co.). It provides a pick mechanism that has a lot of space to move in. The total length may be directly extended according to variation of paper content. It does not need a large space like a swinging arm mechanism, and has a simpler structure and a smaller size. It can provide an automatic compensating capability. The invention also provides a novel composite pickup roller, which rotates only in one single direction in the paper feeding direction. Thus, driving of the pick mechanism is simpler and the complexity of automatic control is reduced.

While the preferred embodiments of the invention have been set forth for the purpose of disclosure, modifications of the disclosed embodiments of the invention as well as other embodiments thereof may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all embodiments, which do not depart from the spirit and scope of the invention.